

## V.J.1 Low Cost Durable Seals for PEMFC

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Contract Number: DE-FG36-07GO17005

Subcontractors:

- Freudenberg-NOK General Partnership, Plymouth, MI
- Henkel Corporation, Rocky Hill, CT
- Virginia Polytechnic Institute and State University, Blacksburg, VA

Project Start Date: April 1, 2007  
Project End Date: March 31, 2009

### Technical Targets

The aim of this project is to develop and evaluate new non-silicone liquid injection moldable (LIM) and dispensable materials to improve durability for both transportation and stationary applications while maintaining or improving on the cost benefits of LIM silicone materials.

**TABLE 1.** DOE Targets Receiving Focus as Part of This Project

Characteristic	Units	2007 Status	2010 / 2011 <sup>a</sup>
Durability	hours	Specification and material development activities have begun	5,000/40,000
Sealability at Low Temperature	°C		-40/-35
Cost <sup>b</sup>	\$/kW		2.70/45.00 <sup>c</sup>

<sup>a</sup> DOE Transportation/Stationary targets

<sup>b</sup> Based on high volume production (500,000 transportation systems per year/2,000 stationary units per year)

<sup>c</sup> Derived from percent cost allocation for seals presented in Reference 1 and applying that result to the corresponding DOE targets



### Approach

Figure 1 provides a detailed summary of the technical approach of the project. The first step in achieving the project objectives will be to establish an initial seal material specification for a PEM fuel cell application and then synthesizing materials that satisfy it. The specification will contain material properties, and their limits, to prevent chemical and mechanical degradation when the seal is exposed to the environmental conditions of a PEM fuel cell stack. It will also contain parameters needed to eliminate interactions between the seal material and adjacent stack components. The initial specification will be guided by the experience base of the team members, and refined by appropriate degradation mechanism studies and material property data. Candidate seal materials will be synthesized and then extensively characterized for both chemical and mechanical properties. The intersection of the material property data and the material specification will provide a subset of materials suitable for PEM fuel cell stack use.

Materials identified through this activity will be evaluated for an extended time under accelerated testing conditions. Up to three will be subjected to ex-situ accelerated life tests at multiple temperatures in relevant environments for up to 4,000 hours. The properties

### Objectives

- Develop a working material specification to guide the development of proton exchange membrane (PEM) fuel cell seal materials.
- Synthesize and compound materials that meet the requirements of the materials specification.
- Evaluate candidate materials through accelerated ex-situ testing to predict whether the material will meet durability objectives given in Table 1.
- Validate the performance of the best performing material candidate through in-cell testing.

### Technical Barriers

This project addresses the following technical barriers from the Fuel Cells section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

(A) Durability

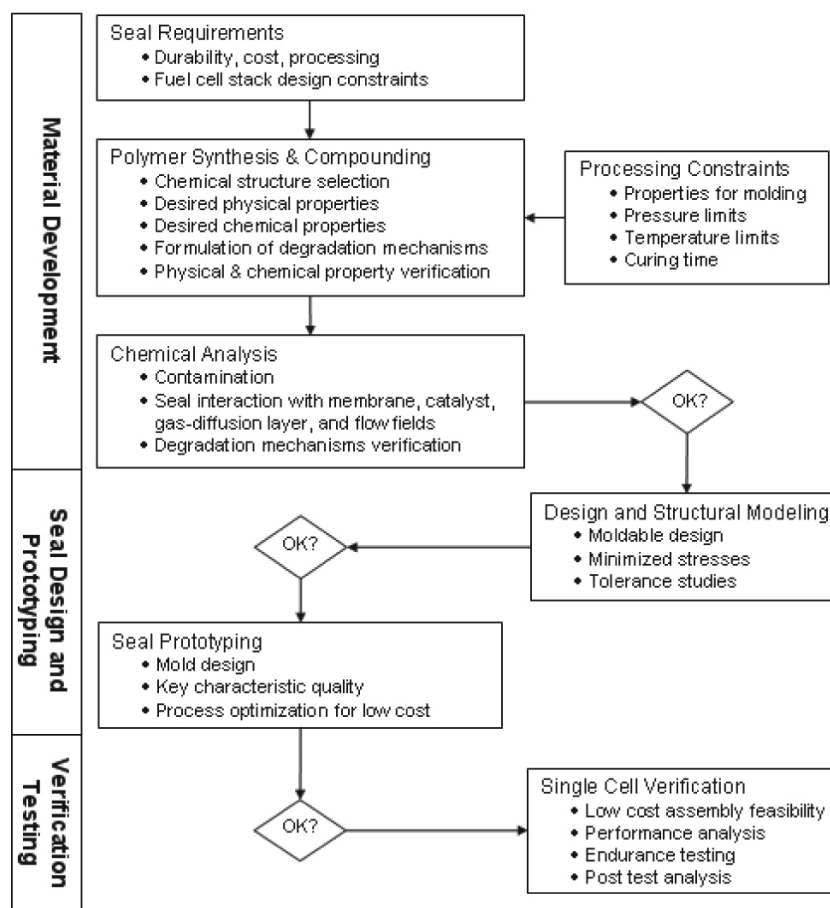


FIGURE 1. Technical Approach to the Project

of the materials will be monitored during these tests to quantify property degradation, with the end-of-test values being used to predict full life. One seal material will undergo single-cell testing. The selected material will be the one that satisfies both the material specification and the seal stress constraints for the single-cell hardware. Prototype seals will be produced, characterized, and ultimately evaluated in the real cell environment for at least 2,000 hours under a test protocol simulating automotive conditions.

The outcome of the project benefits the PEM fuel cell industry by providing a seal material specification, a material that satisfies it, and the verification that the specification and the material enable a low cost and durable seal.

## Accomplishments

The list below highlights some of the current work on the project.

- A working material specification is nearly complete. The specification addresses mechanical properties, processing parameters and operating environment.

- A baseline material has been formulated and produced on the laboratory scale. Initial screening indicates that the material may meet the material specification.

## FY 2007 Publications/Presentations

- George Roberts, "Low Cost, Durable Seal", Oral presentation at the Kickoff Meeting for new Fuel Cell Programs, Washington, D.C., 2007.
- Jason Parsons, "Low Cost, Durable Seal", Poster presentation at the DOE Hydrogen Program 2007 Annual Merit Review Proceedings, Washington, D.C., 2007.

## References

- Stephen Lasher, Jayanti Sinha, Yong Yang, Suresh Sriramulu, "Direct Hydrogen PEMFC manufacturing Cost Estimation for Automotive Applications", DOE Hydrogen Program 2007 Annual Merit Review Proceedings, Washington, D.C., 2007.